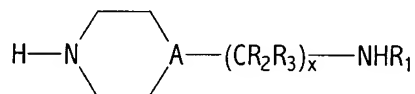


What is Claimed is:

1. A fuel additive composition comprising:

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- a) a Mannich condensation product of (1) a high molecular weight alkyl-substituted hydroxyaromatic compound wherein the alkyl group has a number average molecular weight of from about 300 to about 5,000 (2) an amine having the formula:



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wherein A is CH or nitrogen, R_1 , R_2 , R_3 are independently hydrogen or lower alkyl of 1 to about 6 carbon atoms and each R_2 and R_3 is independently selected in each $-\text{CR}_2\text{R}_3-$ unit, and x is an integer from 1 to about 6;

and (3) an aldehyde, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.1-2:0.1-2;

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- b) a hydrocarbyl-terminated poly(oxyalkylene) monool having an average molecular weight of about 500 to about 5,000, wherein the oxyalkylene group is a C_2 to C_5 oxyalkylene group and the hydrocarbyl group is a C_1 to C_{30} hydrocarbyl group; and
- c) a carboxylic acid as represented by the formula:

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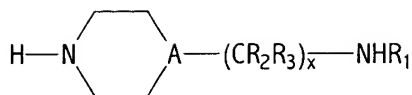


or anhydride thereof, wherein R_4 represents a hydrocarbyl group having about 2 to about 50 carbon atoms, and y represents an integer of 1 to about 4.

2. The fuel additive composition according to Claim 1, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 400 to about 3,000.
3. The fuel additive composition according to Claim 2, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 500 to about 2,000.
4. The fuel additive composition according to Claim 3, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 700 to about 1,500.
5. The fuel additive composition according to Claim 1, wherein said alkyl-substituted hydroxyaromatic compound is a polyalkylphenol.
6. The fuel additive composition according to Claim 5, wherein the polyalkylphenol is polypropylphenol or polyisobutylphenol.
7. The fuel additive composition according to Claim 6, wherein the polyalkylphenol is polyisobutylphenol.
8. The fuel additive composition according to Claim 7, wherein the polyisobutylphenol is derived from polyisobutene containing at least about 70% methylvinylidene isomer.
9. The fuel additive composition according to Claim 1, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 4 carbon atoms, and x is an integer from 1 to about 4.
10. The fuel additive composition according to Claim 9, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 2 carbon atoms, and x is an integer of about 2.
11. The fuel additive composition according to Claim 10, wherein A is nitrogen, R₁, R₂, and R₃ are hydrogen, and x is an integer of about 2.

12. The fuel additive composition according to Claim 1, wherein the aldehyde component of said Mannich condensation product is formaldehyde, paraformaldehyde, or formalin.
- 5 13. The fuel additive composition according to Claim 1, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.5-1.5:0.5-1.5.
14. The fuel additive composition according to Claim 1, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.8-1.3:0.8-1.3.
15. The fuel additive composition according to Claim 1, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:1:1.05.
- 10 16. The fuel additive composition according to Claim 1, wherein said hydrocarbyl-terminated poly(oxyalkylene) monool has an average molecular weight of about 900 to about 1,500.
17. The fuel additive composition according to Claim 1, wherein the oxyalkylene group of the hydrocarbyl-terminated polyoxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ to C₄ oxyalkylene group.
- 15 18. The fuel additive composition according to Claim 17, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ oxypropylene group.
- 20 19. The fuel additive composition according to Claim 17, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₄ oxybutylene group.
20. The fuel additive composition according to Claim 1, wherein the hydrocarbyl group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₇ to C₃₀ alkylphenyl group.
- 25 21. The fuel additive composition according to Claim 1, wherein said carboxylic acid is 1 to about 15% of the weight of the Mannich condensation product.

22. The fuel additive composition according to Claim 1, wherein R₄ represents a hydrocarbyl group having about 8 to about 30 carbon atoms and y represents an integer of 1.
- 5 23. The fuel additive composition according to Claim 22, wherein R₄ represents a hydrocarbyl group having about 17 carbon atoms and y represents an integer of 1.
24. The fuel additive composition according to Claim 1, further comprising a polyolefin polymer of a C₂ to C₆ mono-olefin, wherein the polymer has a number average molecular weight of about 500 to about 3,000.
- 10 25. The fuel additive composition according to Claim 24, wherein the polyolefin polymer has a number average molecular weight of about 700 to about 2,500.
26. The fuel additive composition according to Claim 25, wherein the polyolefin polymer has a number average molecular weight of about 750 to about 1,800.
- 15 27. The fuel additive composition according to Claim 26 wherein the polyolefin polymer is a polymer of a C₂ to C₄ mono-olefin.
28. The fuel additive composition according to Claim 27, wherein the polyolefin polymer is polypropylene or polybutene.
- 20 29. The fuel additive composition according to Claim 28, wherein the polyolefin polymer is polyisobutene.
30. A fuel composition comprising a major amount of hydrocarbon fuel boiling in the gasoline or diesel range and an effective deposit controlling amount of a fuel additive composition comprising:
- 25 a) a Mannich condensation product of (1) a high molecular weight alkyl-substituted hydroxyaromatic compound wherein the alkyl group has a number average molecular weight of from about 300 to about 5,000 (2) an amine having the formula:



wherein A is CH or nitrogen, R₁, R₂, R₃ are independently hydrogen or lower alkyl of 1 to about 6 carbon atoms and each R₂ and R₃ is independently selected in each -CR₂R₃- unit, and x is an integer from 1 to about 6;

5 and (3) an aldehyde, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.1-2:0.1-2;

10 b) a hydrocarbyl-terminated poly(oxyalkylene) monool having an average molecular weight of about 500 to about 5,000, wherein the oxyalkylene group is a C₂ to C₅ oxyalkylene group and the hydrocarbyl group is a C₁ to C₃₀ hydrocarbyl group; and

c) a carboxylic acid as represented by the formula:



15 or anhydride thereof, wherein R₄ represents a hydrocarbyl group having about 2 to about 50 carbon atoms, and y represents an integer of 1 to about 4.

31. The fuel composition according to Claim 30, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 400 to about 3,000.

20 32. The fuel composition according to Claim 31, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 500 to about 2,000.

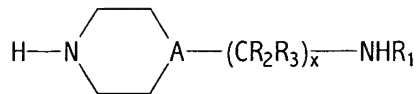
33. The fuel composition according to Claim 32, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 700 to about 1,500.

25 34. The fuel composition according to Claim 30, wherein the alkyl-substituted hydroxyaromatic compound is a polyalkylphenol.

35. The fuel composition according to Claim 34, wherein the polyalkylphenol is polypropylphenol or polyisobutylphenol.
36. The fuel composition according to Claim 35, wherein the polyalkylphenol is polyisobutylphenol.
- 5 37. The fuel composition according to Claim 36, wherein the polyisobutylphenol is derived from polyisobutene containing at least about 70% methylvinylidene isomer.
38. The fuel composition according to Claim 30, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 4 carbon atoms, and x is an integer 10 1 to about 4.
39. The fuel composition according to Claim 38, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 2 carbon atoms, and x is an integer 15 of about 2.
40. The fuel composition according to Claim 39, wherein A is nitrogen, R₁, R₂, and R₃ are hydrogen, and x is an integer of about 2.
41. The fuel composition according to Claim 30, wherein the aldehyde component of said Mannich condensation product is formaldehyde, paraformaldehyde, or formalin. 20
42. The fuel composition according to Claim 30, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.5-1.5:0.5-1.5.
43. The fuel composition according to Claim 30, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.8-1.3:0.8-1.3.
- 25 44. The fuel composition according to Claim 30, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:1:1.05.

45. The fuel composition according to Claim 30, wherein said the hydrocarbyl-terminated poly(oxyalkylene) monool has an average molecular weight of about 900 to about 1,500.
- 5 46. The fuel composition according to Claim 30, wherein the oxyalkylene group of the hydrocarbyl-terminated polyoxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ to C₄ oxyalkylene group.
- 10 47. The fuel composition according to Claim 46, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ oxypropylene group.
48. The fuel composition according to Claim 46, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₄ oxybutylene group.
- 15 49. The fuel composition according to Claim 30, wherein the hydrocarbyl group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₇ to C₃₀ alkylphenyl group.
50. The fuel composition according to Claim 30, wherein said carboxylic acid is 1 to about 15% of the weight of the Mannich condensation product.
- 20 51. The fuel composition according to Claim 30, wherein R₄ represents a hydrocarbyl group having about 8 to about 30 carbon atoms and y represents an integer of 1.
- 25 52. The fuel composition according to Claim 51, wherein R₄ represents a hydrocarbyl group having about 17 carbon atoms and y represents an integer of 1.
53. The fuel composition according to Claim 30, further comprising a polyolefin polymer of a C₂ to C₆ mono-olefin, wherein the polymer has a number average molecular weight of about 500 to about 3,000.

54. The fuel composition according to Claim 53, wherein the polyolefin polymer has a number average molecular weight of about 700 to about 2,500.
55. The fuel composition according to Claim 54, wherein the polyolefin polymer has a number average molecular weight of about 750 to about 1,800.
56. The fuel composition according to Claim 55, wherein the polyolefin polymer is a polymer of a C₂ to C₄ mono-olefin.
57. The fuel composition according to Claim 56, wherein the polyolefin polymer is polypropylene or polybutene.
58. The fuel composition according to Claim 57, wherein the polyolefin polymer is polyisobutene.
59. The fuel composition according to Claim 30, wherein said composition comprises about 20 to about 1,000 ppm of the Mannich condensation product, about 10 to about 4,000 ppm of the hydrocarbyl-terminated poly(oxyalkylene) monool, and about 1 to about 100 ppm of the carboxylic acid.
60. The fuel composition according to Claim 59, wherein said composition comprises about 30 to about 400 ppm of the Mannich condensation product, about 20 to about 800 ppm of the hydrocarbyl-terminated poly(oxyalkylene) monool, and about 1 to about 20 ppm of the carboxylic acid.
61. A fuel concentrate comprising an inert stable oleophilic organic solvent boiling in the range of from about 150°F to about 450°F and from about 10 to about 90 weight percent of an additive composition comprising:
- a Mannich condensation product of (1) a high molecular weight alkyl-substituted hydroxyaromatic compound wherein the alkyl group has a number average molecular weight of from 300 to about 5,000 (2) an amine having the formula:



wherein A is CH or nitrogen, R₁, R₂, R₃ are independently hydrogen or lower alkyl of 1 to about 6 carbon atoms and each R₂ and R₃ is independently selected in each -CR₂R₃- unit, and x is an integer from 1 to about 6;

and (3) an aldehyde, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.1-2:0.1-2;

b) a hydrocarbyl-terminated poly(oxyalkylene) monool having an average molecular weight of about 500 to about 5,000, wherein the oxyalkylene group is a C₂ to C₅ oxyalkylene group and the hydrocarbyl group is a C₁ to C₃₀ hydrocarbyl group; and

c) a carboxylic acid as represented by the formula:



or anhydride thereof, wherein R₄ represents a hydrocarbyl group having about 2 to about 50 carbon atoms, and y represents an integer of 1 to about 4.

62. The fuel concentrate according to Claim 61, wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 400 to about 3,000.

63. The fuel concentrate according to Claim 62 wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 500 to about 2,000.

64. The fuel concentrate according to Claim 63 wherein the alkyl group on said alkyl-substituted hydroxyaromatic compound has a number average molecular weight of about 700 to about 1,500.

65. The fuel concentrate according to Claim 61, wherein said alkyl-substituted hydroxyaromatic compound is a polyalkylphenol.
66. The fuel concentrate according to Claim 65, wherein the polyalkylphenol is polypropylphenol or polyisobutylphenol.
- 5 67. The fuel concentrate according to Claim 66, wherein the polyalkylphenol is polyisobutylphenol.
68. The fuel concentrate according to Claim 67, wherein the polyisobutylphenol is derived from polyisobutene containing at least about 70% methylvinylidene isomer.
- 10 69. The fuel concentrate according to Claim 61, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 4 carbon atoms, and x is an integer 1 to about 4.
- 15 70. The fuel concentrate according to Claim 69, wherein A is CH or nitrogen, R₁ is hydrogen, R₂ and R₃ are independently hydrogen or lower alkyl having from 1 to about 2 carbon atoms, and x is an integer of about 2.
71. The fuel concentrate according to Claim 70, wherein A is nitrogen, R₁, R₂, and R₃ are hydrogen, and x is an integer of about 2.
- 20 72. The fuel concentrate according to Claim 61, wherein the aldehyde component of said Mannich condensation product is formaldehyde, paraformaldehyde, or formalin.
73. The fuel concentrate according to Claim 61, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.5-1.5:0.5-1.5.
- 25 74. The fuel concentrate according to Claim 61, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:0.8-1.3:0.8-1.3.
75. The fuel concentrate according to Claim 61, wherein the respective molar ratio of reactants (1), (2), and (3) is 1:1:1.05.

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76. The fuel concentrate according to Claim 61, wherein said hydrocarbyl-terminated poly(oxyalkylene) monool has an average molecular weight of about 900 to about 1,500.
- 5 77. The fuel concentrate according to Claim 61, wherein the oxyalkylene group of the hydrocarbyl-terminated polyoxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ to C₄ oxyalkylene group.
- 10 78. The fuel concentrate according to Claim 77, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₃ oxypropylene group.
79. The fuel concentrate according to Claim 77, wherein the oxyalkylene group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₄ oxybutylene group.
- 15 80. The fuel concentrate according to Claim 61, wherein the hydrocarbyl group of said hydrocarbyl-terminated poly(oxyalkylene) monool is a C₇ to C₃₀ alkylphenyl group.
81. The fuel concentrate according to Claim 61, wherein said carboxylic acid is 1 to about 15% of the weight of the Mannich condensation product.
- 20 82. The fuel concentrate according to Claim 61, wherein R₄ represents a hydrocarbyl group having about 8 to about 30 carbon atoms and y represents an integer of 1.
- 25 83. The fuel concentrate according to Claim 82, wherein R₄ represents a hydrocarbyl group having about 17 carbon atoms and y represents an integer of 1.
84. The fuel concentrate according to Claim 61, further comprising a polyolefin polymer of a C₂ to C₆ mono-olefin, wherein the polymer has a number average molecular weight of about 500 to about 3,000.

85. The fuel concentrate according to Claim 84, wherein the polyolefin polymer has a number average molecular weight of about 700 to about 2,500.
- 5 86. The fuel concentrate according to Claim 85, wherein the polyolefin polymer has a number average molecular weight of about 750 to about 1,800.
87. The fuel concentrate according to Claim 86 wherein the polyolefin polymer is a polymer of a C₂ to C₄ mono-olefin.
- 10 88. The fuel concentrate according to Claim 87, wherein the polyolefin polymer is polypropylene or polybutene.
89. The fuel concentrate according to Claim 88, wherein the polyolefin polymer is polyisobutene.
- 15 90. A method of improving the compatibility of a fuel additive composition, said method comprising blending together the components of the fuel additive composition of Claim 1, wherein the Mannich condensation product and the carboxylic acid are blended together at a temperature in the range of about room temperature to about 100°C.
- 20 91. A method of controlling engine deposits in an internal combustion engine, said method comprising operating an internal combustion engine with the fuel composition of Claim 30.